1.0 NEED FOR AND OBJECTIVES OF ACTION

1.1 PURPOSE OF THE ENVIRONMENTAL IMPACT STATEMENT

The Environmental Impact Statement (EIS) for Maintenance Dredging Gulf Intracoastal Waterway Texas Section – Main Channel and Tributary Channels was published in October 1975. The EIS identified and evaluated the environmental impacts of continued maintenance dredging of the Texas Section of the Gulf Intracoastal Waterway (GIWW) and tributary channels. In the original EIS, alternatives were addressed that would reduce environmental effects while enhancing economic and social conditions.

The specific action proposed in the 1975 EIS was to maintain the Texas Section of the Gulf Intracoastal Waterway (GIWW) and its tributary channels by periodic dredging of shoal deposits (U.S. Army Corps of Engineers [USACE], 1975). The main channel was maintained at a 12-foot depth and a 125-foot bottom width with tributary channels generally smaller in size than the main channel. Cutterhead suction dredges, using hydraulic pipelines to dispose of dredged material, were the typical means of dredging proposed, with the exception of the Port Mansfield Channel that was to be maintained by hopper dredge (USACE, 1975). At the time of the EIS, the environmental impact and adverse environmental effects of the proposed actions were addressed.

In November 1989, the USACE completed a Reconnaissance Report including an initial appraisal of the entire Texas section of the GIWW. At this time, the question of the inadequacy of the EIS was first raised when an interagency task force (Gulf Intracoastal Waterway Maintenance Dredging Working Group) challenged sections of the existing EIS relative to its compliance with various environmental statutes. The members of the task force included the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), National Park Service (NPS), Texas General Land Office (GLO), and Texas Parks and Wildlife Department (TPWD). Their issue paper, entitled "Evaluation of the U.S. Army Corps of Engineers' 1975 Environmental Impact Statement on Maintenance Dredging of the Gulf Intracoastal Waterway – Texas Section," recommended that a supplemental EIS be prepared (USACE, 1994). Several environmental groups including the Lower Laguna Madre Foundation, the King Ranch, and the National Audubon Society also questioned the environmental effects of open-bay placement practices and the adequacy of the EIS in addressing those effects.

Therefore, the first phase of additional Section 216 studies was initiated in 1993. The focus of this reconnaissance study was to address problems and concerns along the lower reach of the existing, Federally maintained, Texas section of the GIWW. In particular, the purposes of this study were 1) to evaluate commercial shallow-draft navigation operational problems and needs, 2) to address environmental and cultural resources concerns, and 3) to evaluate the potential rerouting of the Channel near Port Isabel (USACE, 1994). The USACE Galveston District was responsible for the general management of that study, with the State of Texas, represented by the Texas Department of Transportation (TxDOT), acting as the local sponsor. In addition, various other Federal and State agencies provided considerable input during this study. A Planning Aid Report was prepared by the FWS and three public scoping workshops were conducted in 1993 (USACE, 1994).

Continuing environmental concerns led to a 1994 lawsuit in the U.S. District Court in Brownsville, Texas, involving the National Audubon Society et al. vs. U.S. Army Corps of Engineers, Civil Action No. B-94-254. Final judgment on this case occurred while the USACE was conducting the Section 216 study described above. The plaintiffs' claims were denied and the case dismissed on October 13, 1994. The plaintiffs appealed the case to the Fifth Circuit Court of Appeals and submitted their brief on October 31, 1995. The USACE agreed to publish a Notice of Intent to Prepare an SEIS, which was published in the Federal Register on February 14, 1996. On April 22, 1996, a stipulation of settlement was filed. The USACE agreed to use its best efforts to complete an SEIS by December 31, 1998; that the USACE would conduct public scoping and evaluate reasonable alternatives in accordance with the National Environmental Policy Act (NEPA); and that the USACE would hold a public scoping meeting in Cameron County before October 1, 1996. Subsequently, three workshops were held with interested groups and a public scoping meeting was held on September 26, 1996.

The recommendations of the task force, coupled with environmental concerns from environmental organizations, and the preliminary findings of the Reconnaissance Study led to finalizing the decision to proceed with a new Draft EIS (DEIS). These processes also resulted in the formation of an Interagency Coordination Team (ICT) to help the USACE develop the scope of environmental studies. Additionally, public meetings and workshops were held to obtain information on issues important to Laguna Madre communities (Section 7).

Therefore, the purpose of this DEIS is to update existing information and provide new information and environmental analysis concerning the placement of dredged material from continued maintenance dredging of the GIWW through the Laguna Madre.

1.2 STUDY AUTHORITY AND LOCATION

A draft Reconnaissance Report for addressing problems and concerns along the reach of the GIWW between Corpus Christi and Port Isabel, prepared under Section 216 Authority, was submitted to the USACE for review in 1994. However, the report contained unresolved issues and was completely revised in 1997 after the issues were resolved. The earlier report focused on navigation problems, environmental and cultural resource concerns, restoration measures and long-term disposal options, and the potential rerouting of the Channel near Port Isabel to reduce traffic delays and navigation hazards. The final report determined that this reach of the GIWW is fully functional and does not include any area which poses serious operational problems for commercial navigation and that there is no Federal interest in a channel realignment plan at Port Isabel. Based on these conclusions, the USACE decided that it would be inappropriate to perform an optimization study of channel dimensions as a part of a feasibility study because 1) it is very unlikely that optimization would result in dimensions greater than those that currently exist due to traffic load and dimensions of connecting channels, and 2) Congressional authorization is not required to maintain a channel at dimensions less than those authorized.

Because the need for an EIS and Dredged Material Management Plan (DMMP) still existed as a result of court action, the USACE determined that studies to reevaluate the economic

feasibility of the project and prepare a DMMP and EIS would continue under the direction of the Dredged Material Management Program and Operations and Maintenance authority.

1.2.1 Project Location

In the 1975 EIS, the Texas Section of the GIWW (from the Sabine-Neches waterway near Louisiana to Port Isabel near Mexico) was broken down into three reaches. Reach 3 included the area between the John F. Kennedy Causeway (JFK Causeway) and the Texas-Mexico border. Within the Reach 3 evaluation, two subsections were evaluated including the Encinal Peninsula to the Lower Laguna Madre (LLM) and the LLM to Port Isabel, Texas. In addition, tributary channels, including the Port Mansfield Channel and the Channel to Harlingen, were addressed.

The Laguna Madre is a long, narrow, hypersaline lagoon extending from Corpus Christi Bay to the southern end of South Bay near the Rio Grande. Since most of the public and agency concerns about the project are with maintenance dredging and placement practices in the Laguna Madre, the project area for this DEIS extends from the JFK Causeway, which joins Flour Bluff to Padre Island, to the old Queen Isabella Causeway, which once joined Port Isabel to South Padre Island, and roughly 1 mile inland on the east and west. Figure 1-1 depicts the northern, middle, and southern reaches of the Laguna Madre project area. The coastline of this area extends across five Texas counties: Nueces, Kleberg, Kenedy, Willacy, and Cameron.

The Laguna Madre is subdivided into two basins referred to as the Upper Laguna Madre (ULM) and the LLM, with the two being separated by the Saltillo Flats (Land Bridge). The Land Bridge consists of an extensive area of sporadically inundated tidal flats, which start approximately 10 miles south of the mouth of Baffin Bay and extend southward approximately 35 miles (Coastal Impact Monitoring Program, 1995). The USACE completed construction of the GIWW in the project area in 1949. Upon completion of the GIWW, the ULM and LLM, once separated by the Land Bridge, became permanently connected. The portion of the GIWW that connects the ULM and LLM is commonly referred to as the "Land Cut."

1.3 EXISTING PROJECT

The Laguna Madre section of the GIWW is a link in the chain of navigable channels which extend from Florida to near the Mexican border. On July 23, 1942, Congress authorized enlargement of the Gulf Section of the Intracoastal Waterway to include the Laguna Madre section (USACE, 1975). A shallow-draft navigation channel 12 feet deep and 125 feet wide was authorized for the entire length of the waterway through this portion. Construction on this project was initiated in 1945 and was completed on June 18, 1949 (USACE, 1994).

For purposes of this project, the Laguna Madre section of the GIWW is 117 miles from the JFK Causeway to the old Queen Isabella Causeway. The channel dimensions today remain at 125 feet wide by 12 feet deep, plus allowable overdraft and advanced maintenance for a total of 16 feet. The main channel requires maintenance dredging every 23 to 60 months in selected reaches to remove approximately 200,000 cubic yards (cy) to 3 million cy (MCY) of sediment (USACE, 1994). Maintenance is

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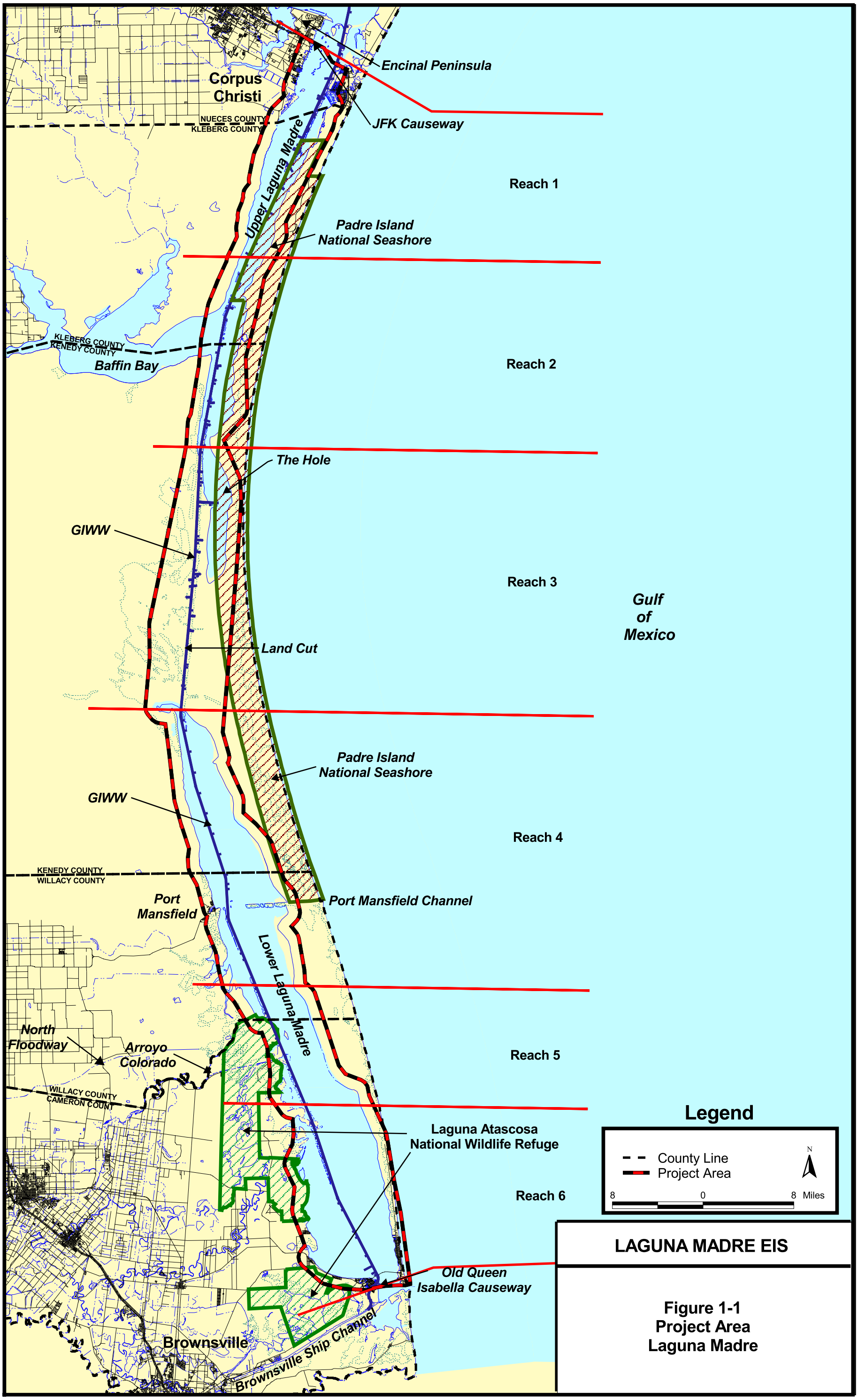

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performed by contracted cutterhead suction dredges, and materials dredged are placed by hydraulic pipeline on both upland and open-bay placement areas. The ULM reach includes three water exchange passes, generally 5 feet deep by 200 feet wide, which were constructed to improve water circulation and fish migration in an area known locally as The Hole (approximately channel mile 590) (USACE, 1975). The LLM reach intersects the GIWW tributary to Port Mansfield (Port Mansfield Channel) and then the Tributary Channel to Harlingen via Arroyo Colorado.

The Laguna Madre main channel section as defined for this DEIS currently utilizes 61 existing placement areas (PAs) for contract pipeline placement operations (Table 1-1). The PAs in this reach are numbered 175 through 240 (excluding PAs 237 and 238, which are used only for Port Isabel small boat harbor channel and PA 205, which is used only for the circulation channel between the GIWW and The Hole) as described below and are depicted on Figure 1-2a through f. There is no record that PAs 175 or 236 have ever been used for placement of maintenance material.

TABLE 1-1

PLACEMENT AREA TYPE AND GENERAL LOCATION

Placement Area	Type	General Location
PAs 175–202	Open-water areas	ULM
PAs 203, 204, 206–208	Unconfined areas	Sand and mud flats
PAs 208–210	Unconfined areas	Sand and mud flats
PAs 211–224, 227–236, and 239	Open-water areas	LLM
PAs 225 and 226	Partially confined areas	Channel to Harlingen
PA 240	Partially confined area	Port Isabel

Periodic maintenance dredging of the Laguna Madre section must be accomplished to prevent shoaling of the channel to depths that would inhibit or curtail navigation, since the GIWW provides the only inland waterway transportation route between the central and lower coastal areas of Texas (USACE, 1975).

1.4 PROBLEMS AND NEEDS

The current dredged material placement practice for the Laguna Madre section of the GIWW, as defined for this DEIS, consists primarily of unconfined open-bay placement with upland placement where it crosses the Land Cut and a few other areas, notably near the mouth of the Arroyo Colorado. As noted above, the main channel through the Laguna Madre has 63 PAs available, of which 61 are intermittently utilized. These sites directly impact over 9,000 acres (ac) of bay bottom (USACE, 1994). Since the publication of the 1975 EIS, several environmental organizations have raised concerns about the environmental effects of open-water placement practices and the level of analyses conducted in preparation of the original report.

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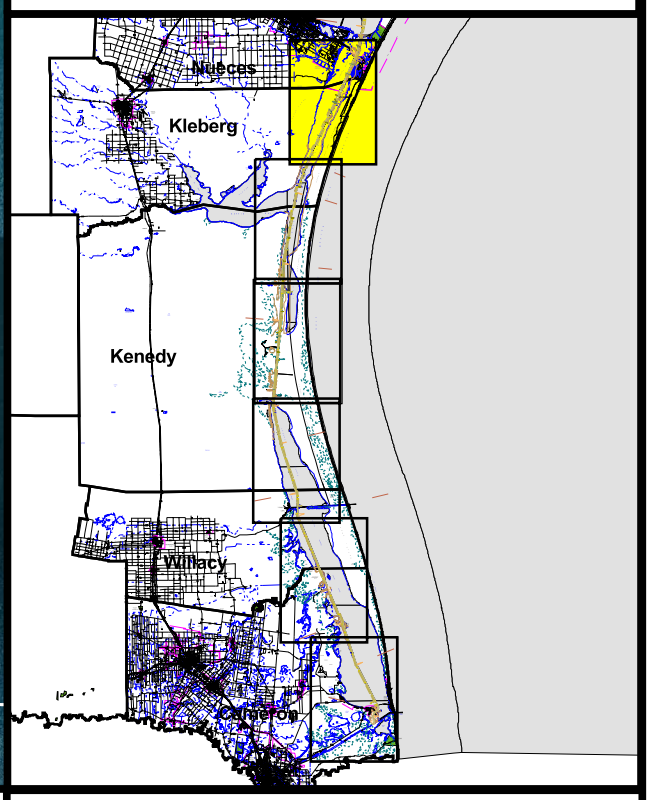
Corpus Christi
Del Oso
Cayo Oso
Oso Creek
JFK Causeway
25+000
22
172
173
174
175
176
177
178
178
179
179
180
180A
181
182
182
182S
183
184
185
185
186
186
187
188
189
189
190
191
Mustang Island State Park
Reach 1
GIWW
50+000
Nueces Co.
Kleberg Co.
Laguna Madre
75+000
100+000
125+000
Padre Island National Seashore
Gulf of Mexico
Reach 1
Reach 2

Project Study Area Inset



N
W E
S

County Line

Project Area

1 0 1 Mile

8000 0 8000 Feet

238 Existing Placement Area

180A New or Extended Placement Area Under Proposed DMMP

221 Placement Areas Excluded From Proposed DMMP

LAGUNA MADRE EIS

Figure 1-2a
Placement Areas
Laguna Madre

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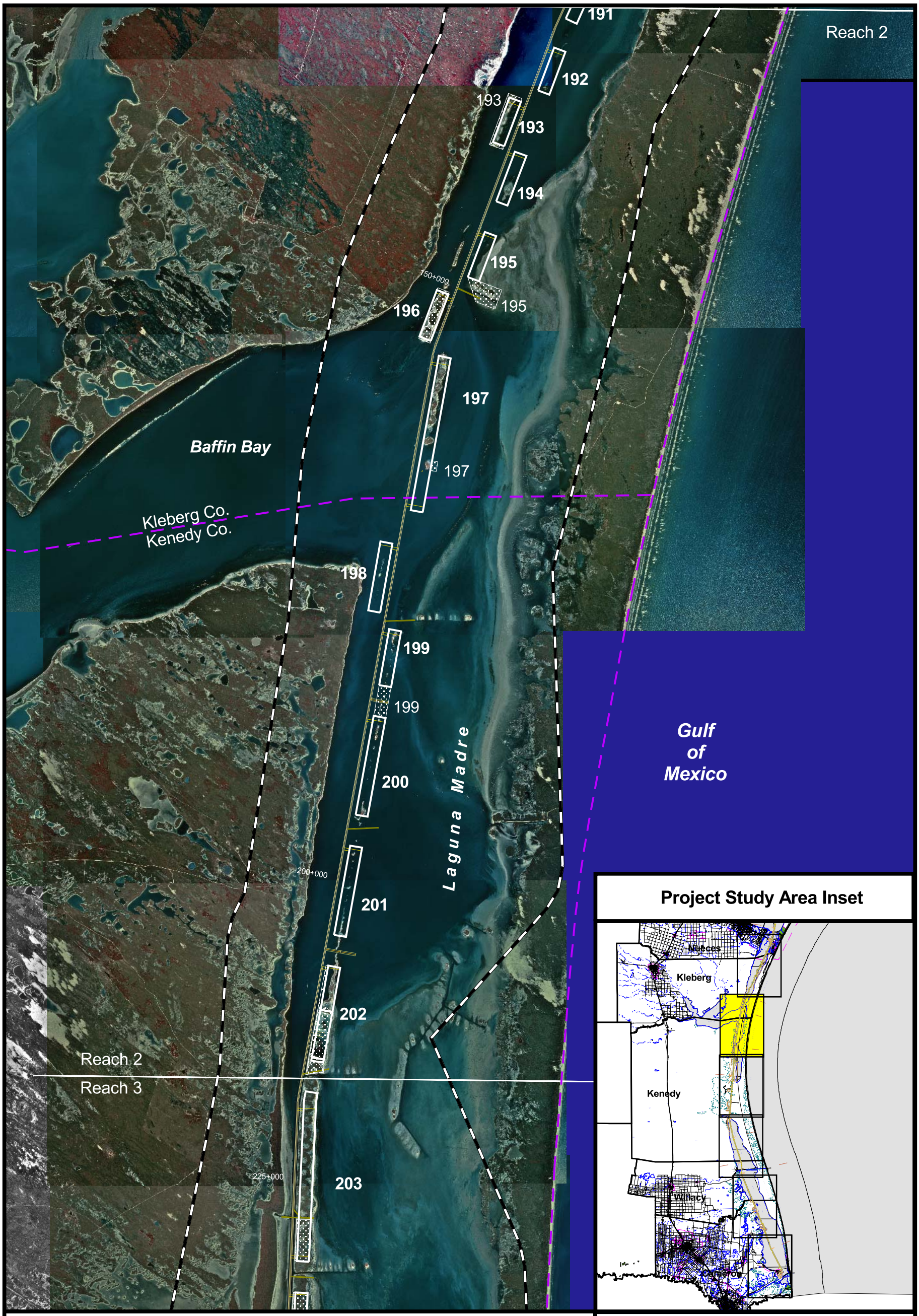

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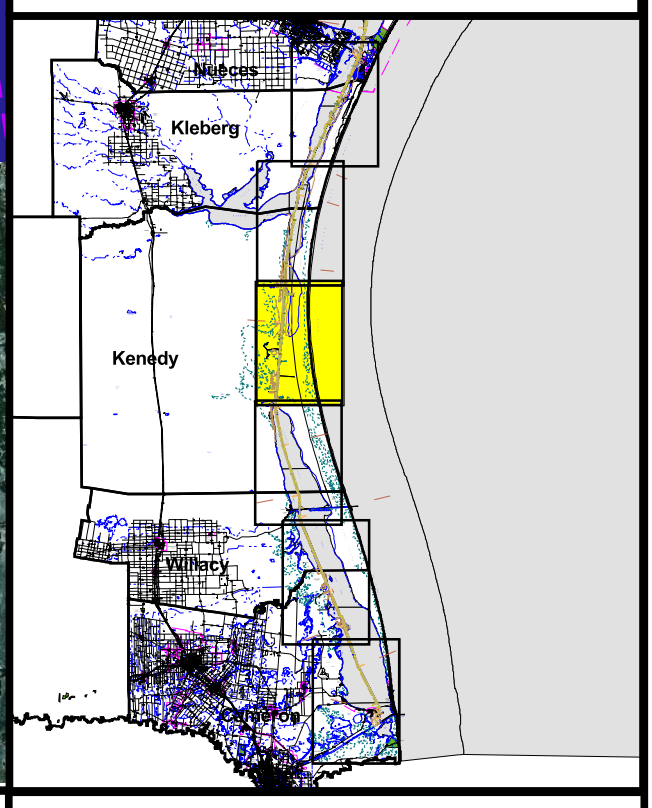
204
205
206
207
208
209
210
250+000
275+000
300+000
325+000
GIWW
Laguna Madre
Gulf of Mexico
Reach 3

Project Study Area Inset



N
W E
S

County Line

Project Area

1 0 1 Mile

8000 0 8000 Feet

238 Existing Placement Area

180A New or Extended Placement Area Under Proposed DMMP

221 Placement Areas Excluded From Proposed DMMP

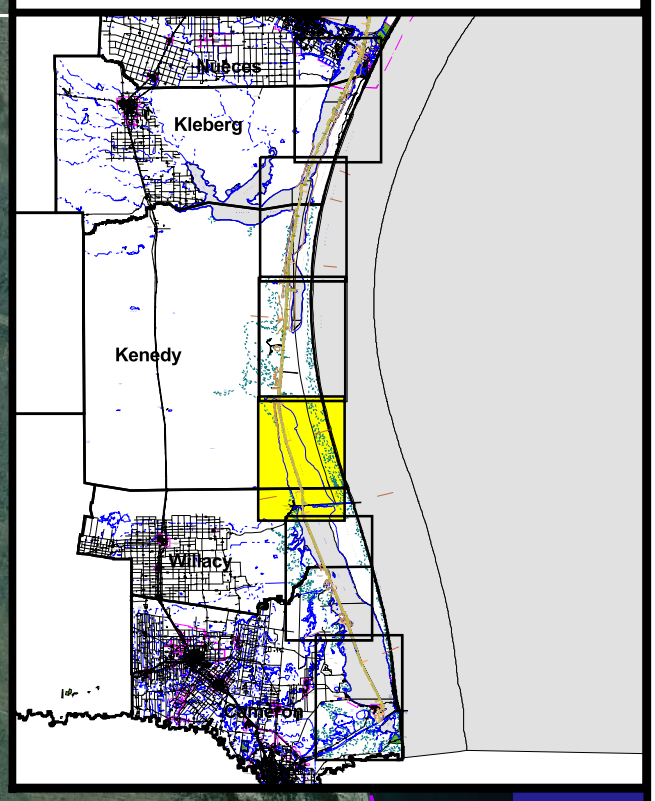
LAGUNA MADRE EIS

Figure 1-2c
Placement Areas
Laguna Madre

File: N:\440319\av\fig1-2c.apr (Fig1-2c)

Reach 3
Reach 4
300+000
275+000
250+000
225+000
200+000
210
211
212
213
214
215
216
217
218
219
220
221
221A
Laguna Madre
RED FISH BAY
Padre Island National Seashore
Kenedy Co.
Willacey Co.
CHARLES JOHNSON AIRPORT
PORT MANSFIELD
PADRE ISLAND NATIONAL SEASHORE
Port Mansfield Channel
186
1006

Project Study Area Inset



N
W E
S

County Line
Project Area

1 0 1 Mile

8000 0 8000 Feet

238 Existing Placement Area

180A New or Extended Placement Area Under Proposed DMMP

221 Placement Areas Excluded From Proposed DMMP

LAGUNA MADRE EIS

Figure 1-2d
Placement Areas
Laguna Madre

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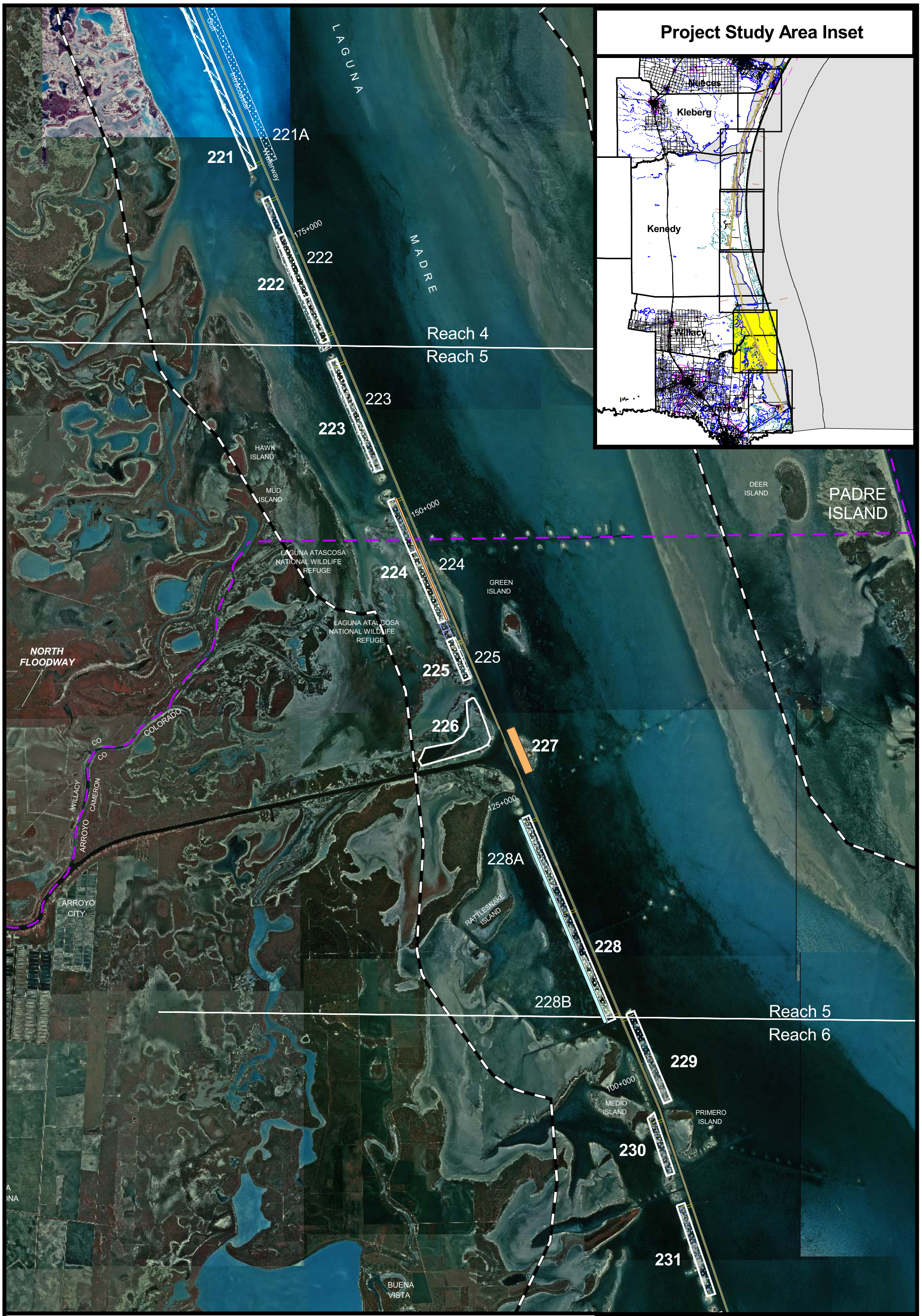

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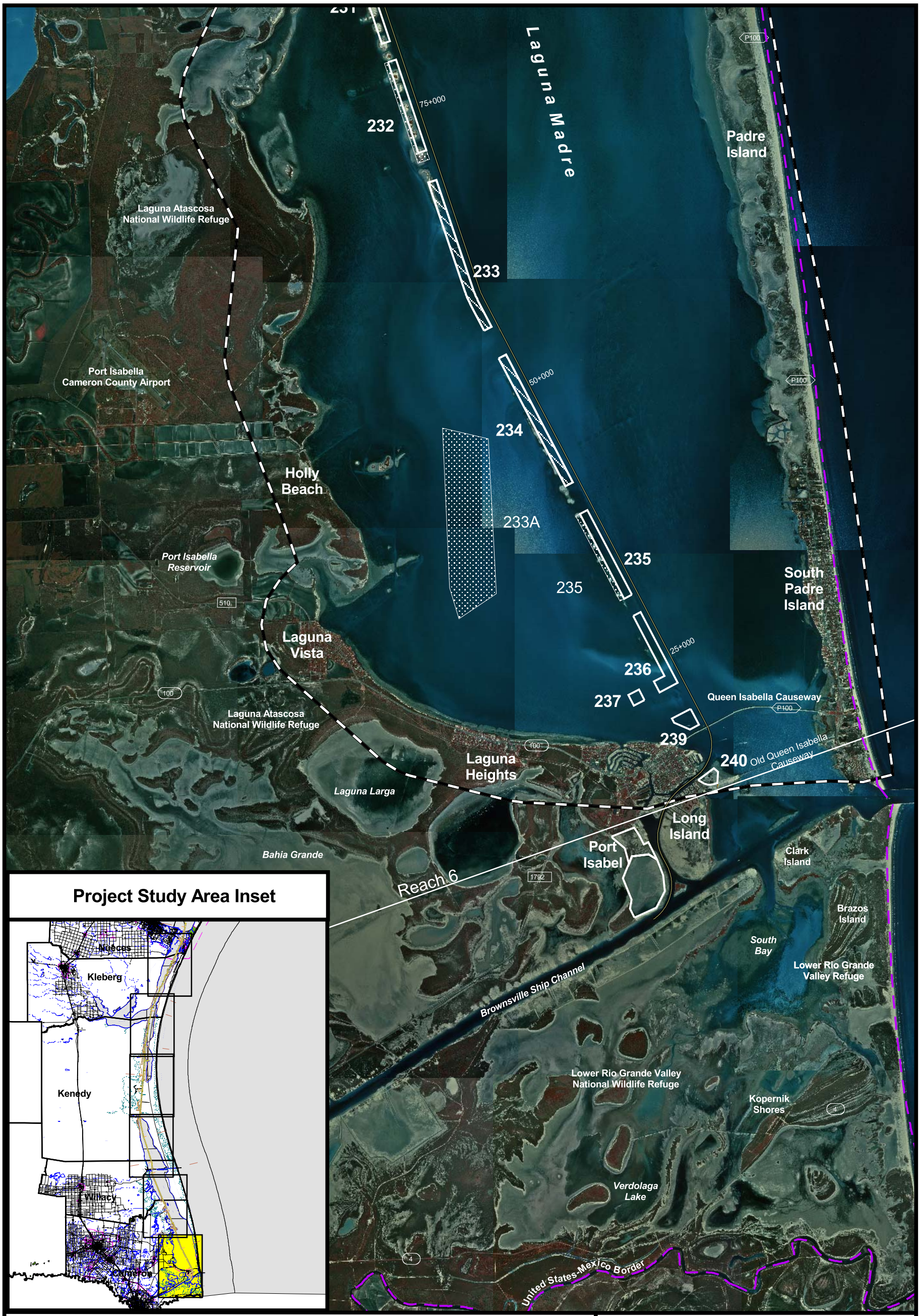

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As presented in Section 1.2, the 1994 Reconnaissance Report focused on navigation problems, environmental and cultural resource concerns, restoration measures, long-term disposal options, and potential rerouting of the Channel near Port Isabel. The revision of the report, in 1997, resolved issues and determined there was no Federal interest in a channel realignment plan at Port Isabel. Additional information gathered from the resource agencies, stakeholders, and the general public was combined with problems previously identified in the operation of the GIWW by the USACE and others to establish a list of the primary concerns that should be addressed during the study process in the Laguna Madre segment of the GIWW. The major concerns identified were:

- the documentation of significant resources of the entire Laguna Madre complex,
- an assessment of how current and future maintenance dredging practices will impact these resources,
- an analysis of how existing maintenance dredging practices can be modified to sustain and restore area resources,
- an estimate of the economic benefits of the existing waterway,
- an analysis of various restoration measures which could be undertaken to offset past dredging impacts to the area, and
- an assessment of studies that should be initiated to address significant portions of the above issues.

The primary concerns outlined above can be further broken down into several key components. Dredging and dredged material placement have the potential to impact the following categories:

- Water and sediment quality
- Coastal community types
- Finfish and shellfish resources
- Wildlife resources
- Threatened and endangered species
- Hazardous, toxic, and radioactive wastes
- Cultural resources
- Socioeconomic resources

The following discussion highlights the major problems associated with each of these topics.

1.4.1 Water and Sediment Quality

The primary water quality concerns for the Laguna Madre include water exchange and inflows, salinity, water chemistry, and brown tide (*Aureoumbra lagunensis*). Because the GIWW is used by commercial barges carrying petroleum products and other cargo, petroleum industry supply vessels, shrimp boats, and recreational boats, the potential exists for the spill of contaminants. Excess turbidity

from dredging and placement activities has also been cited as an area of concern. A key water quality parameter critical to the productivity of the Laguna Madre is salinity. Salinity concerns include the impact that continued dredging or lack of dredging will have on salinity in the system and, subsequently, aquatic productivity. Another concern is the presence of the brown tide and the impacts associated with this phenomenon, including long-term light reduction, the alteration of food webs, and the release of NH_4^+ by dredging activities.

The sediment quality component consists of sediment chemistry, toxicity, and sediment transport. The same concern for the spill of contaminants into the water column exists with the potential for accumulation in sediment. The accumulation of certain contaminants in the sediment of the system can cause toxicological effects on aquatic organisms. Another concern raised is sediment transport, especially the transport of dredged material back into the GIWW.

1.4.2 Coastal Community Types

Coastal community types refer to seagrasses, or submerged aquatic vegetation (SAV); coastal wetlands; sand flats, mud flats, and algal flats; open-water and reef habitat; and coastal shore areas, beaches, and sand dunes. A key concern with dredging and dredged material placement activities is the potential impact to SAV communities, an important component of the Laguna Madre ecosystem. This was a strong focus of the ICT. An SAV modeling subgroup of the ICT was developed specifically to address these concerns. Additional concerns for special aquatic habitat include the filling of large areas of open-bay bottom habitat, and potential erosional problems for coastal wetlands, shore areas, beaches, and dunes with increasing barge traffic in the GIWW. Another concern frequently raised is the compartmentalization of the bay with placement areas. However, the opportunity exists to create SAV habitat with dredged material.

1.4.3 Finfish and Shellfish Resources

The aquatic faunal component of the Laguna Madre system can generally be divided into three categories: nekton, plankton, and benthos, and includes recreational and commercial finfish and shellfish. Concerns have been raised over possible adverse impacts to aquatic resources either by direct placement or by resuspension of contaminants from dredging and placement activities. A key concern and focus of the ICT was on impacts to benthic communities with respect to the placement of dredged material either directly on the community or in the vicinity. Potential impacts to commercial and recreational fisheries have also been a noted concern from stakeholders.

1.4.4 Wildlife Resources

The wildlife resource component of the existing project is fairly small, since the majority of placement activities to date have involved open-water placement. The primary concern regarding impacts to wildlife resources is the placement of maintenance material on rookery islands either displacing habitat or creating land bridges that could lead to increased predation. Conversely, a need has been expressed to enlarge some resting or rookery sites that have eroded. Other impacts to wildlife resources could occur with respect to erosional impacts to coastal wetland, shore, and dune habitats.

1.4.5 Threatened and Endangered Species

The piping plover (*Charadrius melodus*) is a winter resident in the project area, leaving in April–May and returning in July–August. Special studies (see Appendix H) sponsored by the USACE, with the advice of the ICT, were conducted to evaluate the effects of dredged material placement on the ecology of the piping plover. The efforts were focused on understanding how plovers use coastal habitats and how they react to the placement or removal of placement areas. In addition, the entire breeding population of whooping cranes (*Grus americana*) migrates to and winters in the prairies, salt marshes, and bays along the Texas coast, although considerably north of the project area. The green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*), and loggerhead (*Caretta caretta*) sea turtles have been recorded within the Laguna Madre. According to the FWS, portions of the study area have been designated as Critical Habitat for the piping plover.

1.4.6 Hazardous, Toxic, and Radioactive Wastes

As discussed in Section 4.8, the review of available data and a visual reconnaissance indicated minimal risk of the presence, or potential presence, of hazardous, toxic, and radioactive wastes (HTRW) sites within the Laguna Madre (Espey, Huston & Associates, Inc. (EH&A), 1995a). The primary concern that has been raised is the potential for marine transportation and shipping-related spills in the GIWW.

1.4.7 Cultural Resources

The historic resources component of this project includes the cultural history of the project area and identifying potential shipwrecks associated with new placement areas. There is a rich cultural history along the lower Texas coast with a great deal of activity surrounding the Corpus Christi and Brownsville areas. However, since the concerns of the ICT are with maintenance dredging and placement practices in the Laguna Madre from the JFK Causeway to the old Queen Isabella Causeway, both Corpus Christi Bay and the Brownsville area are outside the project area and will not be addressed. However, in the event that a new placement area would be developed, the potential exists for identifying shipwrecks during studies at those sites.

1.4.8 Socioeconomic Resources

This component includes potential impacts to population and employment, commercial and recreational fishing, recreation and tourism, waterborne transportation, land use, and maintenance dredging. Two major concerns raised involve an economic justification for keeping the GIWW open and the counter view of economic impacts of closing the GIWW. The two concerns directly relate to each of the components listed above. Problems associated with changes in waterborne traffic would include safety issues, collisions, accidents, and spills.

1.5 PUBLIC AND AGENCY CONCERNS

Several environmental groups have questioned the environmental effects of the open-bay placement practice described in the 1975 EIS and whether the EIS adequately addressed such effects. These groups have included the Gulf Intracoastal Waterway Maintenance Dredging Working Group (the Working Group), the LLM Foundation, the King Ranch, and the National Audubon Society.

The Gulf Intracoastal Waterway Advisory Committee (GIWAC) was formed in January 1984 by the State to oversee its effort of providing placement areas for the GIWW. The GIWAC is an interagency committee consisting of representatives of the various State agencies. This committee has formed several task forces composed of Federal and State resource agencies, TxDOT, and the USACE to locate and evaluate potential placement areas for dredged material.

In 1986, a GIWAC task force was formed because of continued concerns over SAV impacts from dredging operations, increased predation of colonial waterbird rookeries on existing placement areas, and other impacts from open-bay placement of dredged material. The consensus of the Federal and State agencies was to use upland placement, and three sites were selected on the Padre Island National Seashore (PINS). A public notice was issued and the preparation of an Environmental Assessment (EA) was initiated. In July 1989, the NPS formally withdrew the option of using these three upland sites, citing management mandates and legislative constraints.

The question of the inadequacy of the EIS was first raised in 1989 when the Working Group challenged various portions of the existing EIS as to its compliance with various environmental statutes. The Working Group comprised representatives from the FWS, NMFS, NPS, GLO, and TPWD. Their issue paper, entitled "Evaluation of the U.S. Army Corps of Engineers' 1975 Environmental Impact Statement on Maintenance Dredging of the Gulf Intracoastal Waterway – Texas Section," recommended a new EIS be prepared to comply with the most recent environmental statutes.

A significant portion of the Reconnaissance Study initiated by the USACE in 1993 was to solicit and compile public, stakeholder, and resource agency input and to stimulate involvement. The resource agencies, including FWS-Corpus Christi, NMFS, TPWD, and GLO, were requested to provide input on critical resources within the project area and identify environmental issues and concerns associated with dredging and dredged material placement in the Laguna Madre.

The USACE Galveston District also distributed a public notice in October 1993 to notify the public and stakeholders and asked for problem identification input. A series of public workshops were held in Kingsville, Harlingen, and Port Isabel on December 7, 8, and 9, 1993, respectively. In addition, the FWS prepared a Planning Aid Report describing the baseline conditions of the project area for the USACE Galveston District. The information gathered during these activities was combined with problems previously identified by the USACE and others and incorporated into a list of primary concerns. The general components are described in Section 1.4. A summary of public and agency concerns is presented below:

Dredging/Placement Concerns:

- Discontinuing open-bay placement
- Impacts on future development of upland areas
- Condemnation and use of King Ranch property for placement
- Need for 50-year disposal plan
- Mud flow impacts to aquatic sites outside authorized placement areas
- Improved cleanup after dredging operations
- Marking placement islands
- Filling bay bottoms with dredged material
- Effects of dredged material placement on fish and wildlife and their habitats
- Compartmentalization of the bay with placement areas
- Sedimentation of dredged material into the GIWW

Environmental Concerns:

- Need for an updated Environmental Impact Statement
- Contaminants and water quality
- Increased predation due to placement of dredged material on rookery islands
- Impacts to commercial fishing
- Turbidity during dredging
- SAV losses
- Hydrology of the bay
- Impacts of dredged material on benthic communities
- Effects of the Arroyo Colorado/Channel to Harlingen on the Laguna Madre

Economic Concerns:

- Economic justification for this reach of the GIWW
- Economic impacts of GIWW closure

Safety:

- Shipments of hazardous commodities
- Barges running aground
- Doubling and tripling of barge traffic in the GIWW

1.6 INTERAGENCY COORDINATION TEAM

An ICT was established in 1995 to help the USACE accomplish the goal of developing scientific investigations to address environmental concerns raised by resource agencies and

environmental groups. More information about the ICT, including its charter, can be found in Appendix H. The ICT is composed of representatives from TxDOT, GLO, Texas Commission on Environmental Quality (TCEQ), TPWD, Texas Water Development Board (TWDB), NMFS, U.S. Environmental Protection Agency (EPA), FWS, and USACE, all of which had one vote. There were also two advisory members: PINS, and Coastal Bend Bays and Estuaries Program (CBBEP). Two of the goals of the ICT were to help develop the scopes of work for the environmental studies and to review and critique the study results. The ICT met for the fist time in February 1995 and has met at scheduled intervals throughout the project. This includes 27 ICT meetings, four Modeling Workshops, seven DMMP Workshops, and one Cost Analysis Workshop. The purpose of the ICT was to assist in the development of the environmental documentation for the project that will fully address the environmental concerns for the continued maintenance and operation of the GIWW in the Laguna Madre. Toward this effort, the ICT 1) has assisted the USACE in the development and implementation of the scopes of work for the scientific investigations; 2) has reviewed drafts of the scientific investigations, the DMMP, and DEIS; and 3) will provide a forum for continued coordination on the preferred alternative (DMMP) through the life of the project and provide advice on modifying management plans for the placement areas. Determination of the studies to be performed was normally by consensus. On the rare occasions when consensus could not be achieved, a majority of the voting members allowed for a decision.

Appendix H provides a detailed review of the various studies funded by the USACE. These included:

1. reviews of available information on the water and sediment quality of the Laguna Madre and tributary systems,
2. chemical analyses and bioassays of maintenance material collected from the GIWW through the Laguna Madre,
3. a sophisticated depth profile and bottom classification of the Laguna Madre,
4. analysis of a multi-year data collection effort needed as input for the models,
5. analyses of the effect of past placement of dredged material on benthic organisms and their habitat and fish habitat,
6. a complete sediment budget analysis for the Laguna Madre,
7. the hydrographic and sediment transport models and the seagrass models that were designed to answer critical questions about impacts to seagrasses from dredged material placement, and
8. economic analyses of the GIWW in the Laguna Madre and the economic impact of its closure on the region, and studies on piping plover habitat in the Laguna Madre and the impact of dredged material placement on piping plovers.

1.7 ENVIRONMENTAL CRITERIA

The general environmental criteria for navigation projects are identified in Federal environmental statutes, executive orders, and planning guidelines. It is a national policy that fish and wildlife resources conservation be given equal consideration with other study purposes in the formulation and evaluation of alternative plans. The basic guidance during planning studies is to insure that care is

taken to preserve and protect significant ecological, aesthetic, and cultural values and to conserve natural resources. These efforts also should provide the means to maintain and restore, as applicable, the desirable qualities of the human and natural environment. Alternative plans formulated to improve navigation should avoid damaging the environment to the extent practicable and contain measures to minimize or mitigate unavoidable environmental damages. Particular emphasis should be placed on:

1. protection, preservation, and improvement of the existing fish and wildlife resources along with the protection and preservation of estuarine and wetland habitats and water quality;
2. consideration in the project design of the least disruptive construction techniques and methods;
3. mitigation for project-related unavoidable impacts by minimizing, rectifying, reducing or eliminating, compensating, replacing, or substituting resources;
4. protection and preservation of endangered and/or threatened species; and
5. preservation of significant historical and archeological resources through avoidance of effects. This is the preferable action to any form of mitigation since these are finite, nonrenewable resources.

These criteria were applied to the DMMP to address environmental impacts for various alternatives and to assess possible mitigation features to offset unavoidable impacts.

1.8 RESOURCE MANAGEMENT OPPORTUNITIES

Opportunities were explored in consultation with State and Federal resource agencies to beneficially use dredged maintenance material to create, restore, or enhance the environment in the project area. Restoration of SAV coverage and species distribution, especially in deeper waters and areas near designated open-water placement areas, has a high priority among resource agencies. The system is dependent on SAV for its principal source of primary productivity in a low-nutrient environment that has not developed the salt marshes that are more familiar along the upper Texas coast. In addition, SAV in the Laguna Madre represents a scarce and unique resource because its abundance decreases farther up the Texas coast as water turbidity increases and deeper depths prevent its natural establishment.

A large-scale restoration plan was investigated in the Reconnaissance Study to modify salinity conditions on both the ULM and LLM. Restriction of circulation between the ULM and LLM would allow restoration of the Laguna Madre to a higher salinity condition. This higher salinity condition is more conducive to the growth of shoalgrass (*Halodule wrightii*) than the other seagrass species. However, the salinity in the ULM and LLM would have to be closely monitored to prevent a return to the hypersaline conditions that were prevalent before the GIWW was constructed and which would inhibit or prevent growth of all seagrass. It was concluded that controlling circulation and salinity in the GIWW as it traverses the Laguna Madre as a means of influencing SAV survival and composition meets the criteria for ecosystem restoration. However, this idea was dropped during the Section 216 study because of agency concern for other unintended consequences and the public view that this measure is not desirable.

Continued discussion with the resource agencies in the early sessions has led to the production of a list of additional restoration measures to correct localized problems. These potential measures include:

1. The removal of selected emergent disposal islands that are too close to the mainland, the barrier island, or other islands. These islands allow terrestrial predators, such as coyotes and raccoons, access to larger islands that are used as rookeries by colonial waterbirds. Removal of these islands would allow the colonies to expand to several islands previously abandoned because of heavy predation, especially near the PINS.
2. Dredging of circulation channels between several emergent unconfined placement areas. Dredged material has filled in the shallow areas around some placement areas, isolating several small bays from the Laguna Madre. Better circulation in the area could potentially restore productivity in these bays.
3. Enlarging one or two of the disposal islands located around Mile 615 south of the Land Cut (PA 212). These islands are experiencing erosion. If enlarged, these islands could be used as nesting islands for colonial waterbirds.
4. Armoring PA 220 located on the northeast side of the intersection of the GIWW and Port Mansfield Channel. This restoration measure would protect this unconfined placement area, an important bird nesting island, from further erosion.